A note on typicality*

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The *Selective Modification Model* ($\mathbb{SMM}$) was proposed in Smith and Osherson (1984). It seems to be committed to a false prediction that has so far escaped detection.

Typicality

Consider a concept C and an entity ("object") o. For example, C might be the concept expressed by *red apple*, and o might be an apple bought at the store. Following Rosch (1978) we say that o is "typical" of C to the extent that (in the opinion of a designated individual) o is a good example of C — the kind of object that might be used to communicate the positive extension of C. This definition raises many questions, some of them already discussed in Kamp and Partee (1995); Osherson and Smith (1997) and the literature cited there. To stay focused on essential issues, we limit attention to elementary cases, and assume that typicality can be measured at least ordinally.

A concept is called "simple" if it has monolexemic expression in English, as in *apple* and *red*. Otherwise, it is "complex," for example, *red apple*. (Henceforth, we don't distinguish concepts from their English expression.) Let $\mathsf{Typ}(o,C)$ measure how typical o is of C. Then the accompanying table represents common intuitions about typicality in simple and complex concepts (Smith and Osherson, 1984). $\mathbb{SMM}$ is intended to explain these facts, particularly, to derive typicality for complex concepts from assumptions about the mental representation of the objects and simple concepts in play.

o_1 = a well-formed red apple.
o_2 = a well-formed brown apple.

$\mathsf{Typ}(o_1,\textit{apple})$	$>$	$\mathsf{Typ}(o_2,\textit{apple})$
$\mathsf{Typ}(o_1,\textit{red apple})$	$>$	$\mathsf{Typ}(o_1,\textit{apple})$
$\mathsf{Typ}(o_2,\textit{red apple})$	$<$	$\mathsf{Typ}(o_2,\textit{apple})$
$\mathsf{Typ}(o_2,\textit{brown apple})$	$>$	$\mathsf{Typ}(o_1,\textit{apple})$
$\mathsf{Typ}(o_2,\textit{brown apple})$	$\approx$	$\mathsf{Typ}(o_1,\textit{red apple})$

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SMM

SMM represents concepts in terms of dimensions like shape, size, and color. The "features" of a dimension are its potential realizations, e.g., all the different colors for color. The dimension assigns a numerical value to each feature, with higher values for features that are more typical of the concept. For example, apples are more typically red than green so red has a higher value than green in the color dimension for *apple*. Each dimension also carries a scalar quantity called its "diagnosticity" that reflects how important the dimension is to typicality. For example, color and shape are more diagnostic of *apple* than is the number of seeds.

When evaluating objects for typicality in a given concept, the object is associated with the same dimensions as the concept, but numerical values are concentrated on the features actually possessed by the object. For example, a Macintosh apple has all its color invested in red. Object representations do not assign diagnosticity to dimensions since diagnosticity is inherited from the concept at issue. The typicality of object o in concept C is computed as the similarity of their representations, specifically, as the weighted sum of feature overlap in each dimension; the weights are given by the diagnosticity of the dimension. Feature overlap can be measured in various ways including the Contrast Model (Tversky, 1977), employed in Smith et al. (1988). Even this rough description shows how SMM predicts the first inequality in the table above. It remains to see how the model constructs complex concepts from simple constituents.

SMM is designed only for adjective-noun combinations in which the adjective corresponds to a single dimension in the noun, as in *red apple*. It does not apply, for example, to *expensive apple* inasmuch as *expensive* concerns several dimensions of *apple*. Let f be the feature named in a single-dimension adjective, and let D be f's dimension. The adjective-noun concept results from shifting all the numerical value in the noun's dimension D to f; other features are set to zero. In addition, the diagnosticity of D in the noun concept is increased. For example, the representation of *green apple* is the same as that for *apple* except that green receives all value for color, and the diagnosticity of color in *green apple* is greater than that in *apple*. Notice that the representations of *apple* and *red apple* are similar except that color has greater diagnosticity in the latter than in the former. The second fact in our table is explained thereby. The remaining facts are easy to derive. A more detailed and comprehensive treatment is provided in Smith et al. (1988).

The error

Let o_{red} be an appropriately shaped, perfectly red apple. Let o_{brown} be just like o_{red} except that it is perfectly brown. Consider the continuum of apples extending from o_{red} to o_{brown}, each of the same shape but changing colors gradually from red to brown. An

applie positioned a short distance from o_{red} will still look red but not perfectly. As we proceed toward o_{brown}, the color will lose more and more of its redness in favor of increasing brownness. It seems clear that there is an apple o_{mid} somewhere near the middle of the continuum such that:

(1) The color of o_{mid} is equally similar to red and to brown.

Suppose that $\mathbb{SMM}$ is accurate, and consider *red apple* and *brown apple*. The representations of these two concepts are identical except that the first concentrates its color on red, the latter on brown. Moreover, the two concepts have the same diagnostic weight on each dimension (enhanced for color in both cases). Hence by (1):

(2) The mental representation of o_{mid} is equally similar to the mental representation of *red apple* as it is to the mental representation of *brown apple*.

Since similarity of mental representation determines typicality, (2) yields:

(3) $\mathsf{Typ}(o_{mid}, \textit{red apple}) \approx \mathsf{Typ}(o_{mid}, \textit{brown apple})$.

But (3) is clearly wrong. The color of o_{mid} is not very red so it is a poor example of *red apple*. On the other hand, o_{mid} is somewhat brownish so it is a pretty good example of *brown apple*. (I trust that the reader agrees with these intuitions.) Hence, $\mathbb{SMM}$ [which implies (3)] cannot be maintained. The problem appears to be that the intepretation of color adjectives depends on the nouns they modify. How to incorporate such relativity into $\mathbb{SMM}$ is an open question. Related defects in $\mathbb{SMM}$ are documented in Medin and Shoben (1988).

References

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